

CAPITALISING ON COAL KINETICS

Dr James Counter, Nalco Water, Australia, examines the opportunities for increased recovery and yield by optimising flotation kinetics and explores how a mechanical technology can supplement chemical solutions to maximise flotation performance.

In coal handling and preparation, flotation is a critical process used to maximise the capture of fine coal particles. Fine particles can impact yield, recovery, and grade, which are particularly important to the value of the finished product. Plant operators are continually looking for opportunities to optimise their flotation circuits, examining coal hydrophobicity, selectivity, and froth stability among other areas. All too often, flotation kinetics are the limiting factor in the process.

Mining and mineral processing specialists at Nalco Water believe that improvements in flotation kinetics can increase fine coal recovery and decrease the cost of reagent consumption. They actively look for opportunities to improve flotation kinetics and utilise a mechanical solution in addition to their chemical innovation to enhance coal flotation.

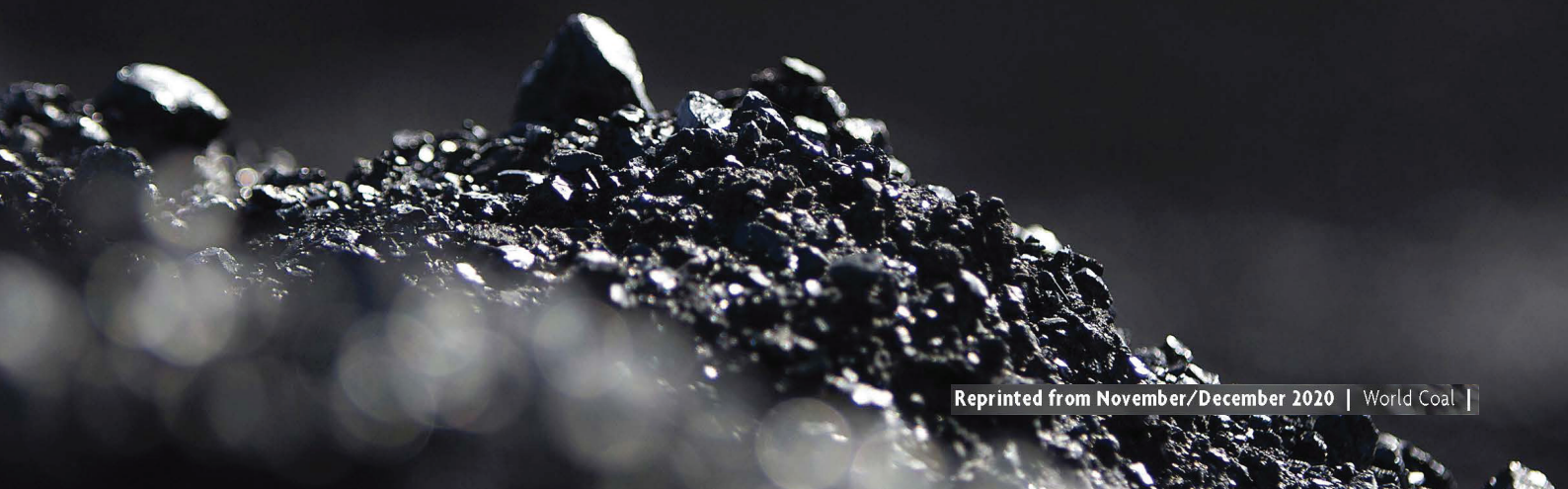
A solution called Flotefeed was designed to increase flotation kinetics, particularly when mixing energy or conditioning time are limiting factors, in the form of dosing equipment that

introduces the reagents into the slurry in a highly-dispersed form to encourage rapid absorption of the collector and fast attachment of the frother to the bubbles – a dosing method that can reduce reagent consumption by up to 30%.

Case study 1

In a recent example, a metallurgical coal mine and processor located in eastern Australia, decided to utilise FloteFeed in tandem with a frother and collector to help resolve flotation circuit control issues for a complex coal operation. The processing plant processes approximately 1.9 million tpy of high-grade metallurgical coal for domestic and international markets from several coal seams throughout the site.

The company was already working with the operation on site, treating the clarified water circuit, when engineers noticed the miner was experiencing difficulties with control of the float circuit. It was believed that the challenges were a result of



the different flotation behaviours of the coal blend from multiple seams, as well as the existing chemical dosing strategy.

After several conversations with plant management and operators, the company proposed a series of tests to examine the effect of the plant's collector and frother reagents on the coal blend, with the goal of improving the yield from the fine coal circuit. FloteFeed would be used with the reagents to dispense them into the slurry.

Within hours of the first site trial, the site reported that the technology had helped establish operational control of the float circuit. Subsequent trials, across the coal from the different seams, confirmed that the programme had resolved the control issue.

The reagents for the trial and new dosing programme included NALFLOTE™ frother and collector technology and the FloteFeed G3 dosing equipment completed the package. Industry-proven, the two highly selective flotation reagents have been developed to maximise fine coal recovery rates at minimal costs. When coupled with the dosing technology, the solution helps to maximise yield, and ultimately, increase profitability.

Recent production figures have confirmed that a 4 – 5% increase and reagent savings of the programme delivered a return on investment in the vicinity of 5 – 6% for the coal processor.

Concurrent with the trials and subsequent introduction of the new float circuit control programme, the miner has completed a major overhaul of the preparation plant, including a thickener upgrade along with float cell and water clarification improvements. The combined effect will continue to improve fine coal throughput and productivity for the prep plant. Nalco Water will continue to partner with the mining operation to monitor the flotation circuit, helping to ensure that optimal performance and profitability is achieved throughout.

Case study 2

In another example, FloteFeed was applied to help a coal handling and preparation plant improve their yield and process stability. Located in south-east Australia, the plant had been previously decommissioned and was in the process of coming back online to process coal from a single underground seam. Nalco Water supplied the plant with flotation reagents prior to its retirement, and was engaged to help supply flotation,

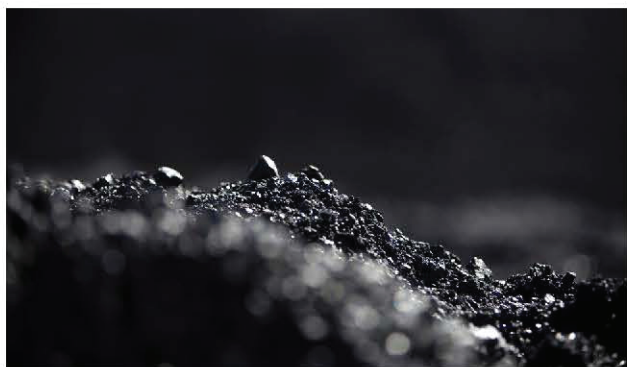


Figure 1. Nalco Water flotation reagents and equipment have been developed to help maximise yield, recovery and profitability of the final coal product.

dewatering, clarification, and anti-scalant solutions for the recommissioned operation.

To bring the operation back online, the plant needed to perform extensive work to the previous flotation circuit and horizontal vacuum belt dewatering process. Upon the initial launch of the recommissioned operation, the performance of the horizontal vacuum belt was poor. The filter cake was very wet, and flotation was restricted to stop the belt from discharging sloppy cake product. At this stage in the recommissioning, the flotation yield was approximately 27 tph – falling short of the 75 tph that the plant had set as a target for the coal seam.

First, the horizontal vacuum belt dewatering process was examined, as it was limiting the plant from optimising their flotation circuit. FloteFeed was already applied to the collector feed and was delivering a 15.6% yield increase (as compared to the feed when the solution was deactivated). It was suspected that more could be done to optimise flotation kinetics, but the dewatering challenges of the horizontal vacuum belt needed to be addressed. The Nalco Water team worked with the plant to diagnose cake capillary issues and helped to optimise the flocculant application to open the capillaries. Once this was achieved, the plant could now run more flotation product to the horizontal vacuum belt.


The plant performed multiple adjustments to maximise the yield of the flotation circuit, but the yield was still lower than site expectations. To improve flotation kinetics further, the addition of FloteFeed technology to the NALFLOTE frother feed in conjunction with the collector feed was proposed. The team believed that the plant could achieve the designated yield targets with the additional system.

Immediately, control room operators noted that the system on the frother helped improve plant stability. In tests performed by the plant, operators found that the optimised flotation circuit returned coal to the horizontal vacuum belt much faster. Prior to the application on the frother feed, it had taken 15 minutes for cake discharge to arrive on the horizontal vacuum belt. With the optimised flotation circuit, the process took 6 minutes.

The final flotation programme for the recommissioned plant was similar to the solution presented in the previous example. A NALFLOTE frother and collector technology was used to enhance stability and selectivity, and combined the chemical programmes with dosing equipment to optimise the flotation kinetics of the circuit.

The improved flotation kinetics helped to deliver 12.75 tph over the first 2 weeks of optimised operations. The yield increase was significant, and the plant ultimately achieved 85 tph – a target that was slightly above their initial goals from the coal seam. The overall profitability of the plant improved to a total of more than AUS\$8 million / yr.

Conclusion

Enhancing flotation kinetics can help processing plants maximise the performance of their coal flotation circuits. The combination of mechanical feeding technology with performance frother and collector reagents can help plants overcome challenges with flotation kinetics to improve recovery, yield, and ultimately, their bottom line. 

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